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DEVELOPMENT OF TRAX I: A TANK PLATOON GAME MODIFYING DUNN-KEMPF

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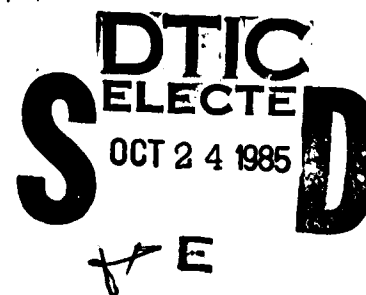
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CONTENTS

	Page
Introduction	1
Purpose of Development	1
Requirement	1
Armor Training System	1
Objectives	3
Background	4
Tactical Training Research	4
Developmental Criteria	7
Development Procedures	11
Rules Development	11
Scenario Development	12
Initial Tryout	13
Revision of Rules and Materials	14
Final Validation and Revisions	15
Results	16
Conclusions	17
References	17

INTRODUCTION

This report describes the development of TRAX I, a combat gaming method supporting leader training prerequisites in the Division '86 ARTEP Mission Training Plan (MTP) for the tank platoon. TRAX I is adapted from the Dunn-Kempf game for platoons (US Army Training Support Center, 1984). The game system is designed to represent a US tank platoon executing Division '86 tactics while performing common platoon missions. With minor additions to the rules and materials, the game system can also be used with mechanized infantry platoons. In the game, the platoon leader, platoon sergeant, and tank or track commanders simulate communication, fire, and movement actions of their own vehicle using miniatures on a terrain board.

Three game controllers are required to operate the game system. The Instructor/Controller manages the sequence of play, simulates communication by the company commander and other sources external to the platoon, and evaluates overall tactical performance. The Opposing Force (OPFOR) Controller carries out actions of the enemy according to a predetermined scenario and schedule of events. The Fire Controller determines the effects of direct fire engagements by the US and OPFOR weapons, and schedules and determines effects of indirect fire for both sides.

Exercise plans used with the TRAX I system are based on missions and tasks of the Situational Training Exercises (STXs) outlined in ARTEP MTP. Sample exercises for the tank platoon were developed based on STXs in the tank platoon MPT, FC 17-15-1 (US Army Armor School, 1984a). The OPFOR actions and other scenario events are scheduled to provide appropriate conditions for the execution of specific platoon tasks. Gaming exercises with TRAX I provide tactical training preparing leaders to conduct STXs in the field. When the opportunity to practice some tactical tasks and STXs in the field is lacking, TRAX I may be used to provide substitute training. TRAX I also provides a gaming framework adaptable for research on leader training and effects of future battlefield conditions.

Purpose of Development

Requirement. The general impetus for this development effort was provided by the Close Combat (Heavy) Mission Area Analysis and Army Training (1990) studies that pointed to improvements needed in tactical training for leaders of small units, including needs to update and improve battle simulation methods supporting training. Tactical training has been seriously limited by resource constraints involving time, space, and costs of field exercises. Increased reliance on simulation methods for training is the primary means available to overcome these constraints, and to attain the degree of tactical proficiency required for combat readiness.

Armor Training System. The specific need for development of a platoon level combat gaming method arose from recent changes in the approach adopted for training Armor units. These changes have resulted both from the introduction of new equipment and updated doctrine in the Division '86 organization, and

the evolution of a multilevel total training system concept that focuses training development on the ultimate criterion of readiness, the unit's capability for mission accomplishment.

The US Army has progressively adopted and institutionalized a "systems approach" to training, and implemented instructional systems development (ISD) methods with increasing success over a number of years. Until recently, however, applications to collective training were hampered by difficulties in defining collective tasks and training objectives.

With the adoption of the mission as a central organizing concept, and the use of a mission-based, top-down approach to task analysis, these difficulties have begun to be overcome. The Division '86 training literature shows evidence of this progress. The new ARTEP 71-2 (Department of the Army, 1981) identifies and catalogs collective tasks executed by tank, infantry, and combat support units at every level in the mechanized infantry/tank task force. The ARTEP together with Division '86 field manuals (Department of the Army, 1984abc) for the tank platoon (FM 17-15), company (FM 17-16), and battalion (FM 17-17) permit the actions of leaders and followers in performing collective tasks to be specified in considerable detail.

On the basis of this literature, a total training system for the Armor force is under development. The current status of this system is described in recent presentations by MG Brown (1984) and BG Sullivan (1984). The tactical components of this system are outlined for the tank platoon (FC 17-15-1), the tank heavy company team (FC 17-16-1), and tank battalion/task force (FC 17-17-1) (US Army Armor School, 1984abc). The recommended task force unit training program is presented in FC 17-11 (US Army Armor School, 1984d). At the platoon level the components include platoon drills, situation training exercises (STX), field training exercises (FTX), and other coordination exercises (FCX) among leaders, all using actual equipment in available field training areas.

The MTPs emphasize the importance of training leaders prior to performing platoon tasks on a unit basis in drills and exercises. Training objectives are provided for the platoon, but the instructor is required to derive leader objectives from these. Methods of leader training are recommended, including map exercises (MAPEXs), sandtable exercises, terrain walks, tactical exercises without troops (TEWTs), and gaming simulations, in particular using the Dunn-Kempf game. However, little guidance is provided on the specific way these methods should be used to prepare leaders for participation in drills, STXs, or FTXs.

On examination, the Dunn-Kempf game did not appear entirely compatible with a program of frequent, highly structured tactical training. The rules and combat resolution tables had been extensively revised after the game's original fielding. The revision attempted to increase the communality of the game system and weapon system data with Blockbuster. The latter game was designed primarily to represent infantry combat in urban areas, and the complexity of the combat resolution procedures was substantially greater than the original version of Dunn-Kempf. Complex procedures tend to slow play, requiring a lengthy training session to complete an exercise. As a result,

few gaming exercises can be conducted in the divided training time available to most units. Furthermore, the Dunn-Kempf rules and materials did not reflect Division '86 weapon systems and organizations, so that some supplements and modifications were needed to provide leader training based on current doctrine.

A major impediment to training with Dunn-Kempf derives from the free-play two-sided structure of the game. The STXs and FTXs of the MTP are based on training hierarchies specifying a number of platoon tasks embedded within the performance of a particular mission, or mission segment. In a free-play game, the occurrence of a requirement to perform any particular task cannot be guaranteed, and the course of play can vary markedly from game to game. Players on the OPFOR side are not required to employ OPFOR tactics, and often may respond to US player actions in unrealistic ways. Thus leader training with Dunn-Kempf can be expected to provide training only on a portion of the prerequisite leader tasks at best, and the content and effects of training could vary widely among individuals practicing the same mission in the game.

Considering these problems, the need to develop a new gaming method to support leader training in the MTP was evident. An effective battle simulation for leader training should contribute to more efficient utilization of resources in implementing the MTP, since well-prepared leaders should require fewer repetitions of the STXs and FTXs to correct deficiencies in leader and platoon performance. The platoon level was chosen since gaming systems available at higher levels are less dependent on particular weapon capabilities and tactics, and thus are more easily modified for Division '86 training.

Objectives. The primary objectives of the development effort were three-fold:

- (1) To provide a combat gaming system for leader training supporting the platoon MTP, providing practice on specific prerequisite leader tasks.
- (2) To incorporate Division '86 doctrine on weapons systems, organizations, and tactics into the combat simulation represented by game events.
- (3) To develop game materials and procedures that tend to facilitate the availability and implementation of combat gaming methods under the constraints imposed by local unit resources for leader training.

A secondary objective was to develop a platoon gaming system contributing to future research and development efforts. For this purpose, combat gaming methods are needed to provide a baseline for design and evaluation of computer-assisted or computer-controlled battle simulations, and to establish a framework for research on leader training and effects of future battlefield conditions projected in AirLand Battle doctrine.

BACKGROUND

To fight effectively on the modern battlefield, the leaders of a tank platoon must perform a multiplicity of competing and complex tasks under extreme time constraints and conditions of stress. Those who complete their tasks, have the good fortune to survive, and go on to accomplish their missions will have certified their abilities as experienced combat leaders. The training challenge is to instill in inexperienced platoon leaders, platoon sergeants, and tank commanders a substantial portion of the veteran's skills before the first battle. The training challenge is redoubled by the fact that only limited means of creating future battlefield conditions are possible in a practice environment.

Tactical Training Research. The literature on tactical training for ground combat has been reviewed by Shriver, Henricksen, Jones, and Onosko (1980), Taylor (1983), and Henricksen, Jones, Sergeant, and Rutherford (1984). Only those findings directly related to the present effort are summarized here.

Training Approaches. Aside from standard classroom instruction on the concepts and principles of tactics, three main training methods are used now or planned in future to provide opportunities for the practical application of tactics in a simulated combat environment. These methods are engagement simulation, computer-automated battle simulations, and combat games.

Engagement simulation is an extension of traditional field exercise techniques to include two-sided simulation of weapon system functioning and real-time casualty assessment. The most recent version that has been widely distributed for use in the US Army is the Multiple-Integrated Laser Engagement System (MILES). This system uses laser emitters attached to weapon systems and laser detectors on personnel and vehicle targets to simulate direct fire. An important aspect of engagement simulation is the after-action review, which relates individual and collective actions to combat consequences in terms of casualties and mission accomplishment. Despite its potential benefits, engagement simulation is limited by resource constraints like other field exercises, and is hampered by other logistical and controller support problems as well (Scott, 1980). As a result, engagement simulation has not been fully implemented on a regular basis by most units. The main practical benefit of engagement simulation may be to provide a context for the demonstration and evaluation of tactical proficiency, rather than serving as the main vehicle for training.

Computer-automated battle simulations are designed to represent the battlefield environment together with weapons system operation in that environment. Systems for battle simulation combine computer computation models developed for combat simulation in military operations research with control/display hardware derived from training device technologies. Until recently, visual displays were not capable of fully representing ground level combat, so the major applications were at higher command levels where direct visual simulation of the battle is not needed for command and staff training. The Combined Arms Tactical Training System (CATTs) used at the Command and General Staff School is a notable example. The CATTs provides the information flow required for effective simulated CPXs for battalion staff groups.

The Army Training Battle Simulation System (ARTBASS), soon to be fielded Army-wide, has been developed as a mobile version of CATTs (US Army Training Support Center, 1984).

Interest in development of computer-automated battle simulation to support training at platoon and company level has grown as the technological capabilities for computer animation and computer networking has increased. The Army has completed development of a sophisticated gunnery trainer (the Unit Conduct of Fire Trainer, U-COFT) presenting computer-generated visual imagery. However, the cost of linking such devices to provide a platoon simulation for leader training is prohibitive (Bessemer, 1980). Research and development work on lower cost alternatives has begun, but the length of the device development process will not permit such a device to be fielded for a number of years (Andrus and Nagengast, 1984).

In the interim period, the primary low-cost training method available to units in the field must continue to be combat gaming systems. Military gaming methods trace their origins to the Prussian "Kriegspiel" used in the 1880s both for training and operational planning. Prussian officers moved color-coded wooden blocks representing units over large detailed maps. Maneuver and use of armaments were planned and executed, followed by an analytic discussion and critique. Map exercise (MAPEXs) and similar sandtable exercises for small units have continued to be used by all armies in one form or another since that time. However, it was not until the early 1970s that the US Army developed and distributed formal game rules and equipment lots to support tactical training at a variety of organizational levels. Fielding of the gaming systems coincided with a public wave of interest in commercially developed wargames and military miniatures play that provided important innovations in gaming techniques, many of which were incorporated in the Army games. Gaming systems currently available (US Army Training Support Center, 1984) include Dunn-Kempf and Blockbuster at the platoon and company level, and Pegasus, First Battle, and War Eagle for levels from battalion to corps. In addition, a computer-assisted game (Combined Arms Map Maneuver System, CAMMS) uses telecommunications to a time-sharing computer for battalion and brigade-level training exercises.

The Dunn-Kempf and Blockbuster games were more useful as sources of game elements in the present project. The Dunn-Kempf game was initially developed as an adaptation of British miniature rules (Combined Arms Training Developments Activity, 1978). The game kit provides a scaled three-dimensional fiberglas terrain board, and miniatures representing US and OPFOR vehicles and weapons systems. The original rules and components were designed to represent mid-1970s organizations in European scenarios. However, the basic method remains valid when supplemented with newer miniatures, updated weapon system data, and locally constructed terrain boards.

The Blockbuster game was designed in the late 1970s to support infantry training for combat in built-up urban areas. It provides a detailed model of a typical European small town with a board showing the surrounding terrain at lower scale. Vehicle models and weapons data are more recent and comprehensive. The Blockbuster rules were used as the basis of an early 1980s revision of the Dunn-Kempf rules (US Army Training Support Center, 1981) that

unified the combat resolution tables and procedures for the two games. However, neither game system has been influenced by more recent developments in Division '86 equipment, organization, and tactical doctrine.

Effectiveness of Combat Gaming. There are few objective research findings that quantitatively evaluate the training effectiveness of combat games used by the US Army, or establish transfer of training from game experience to field performance. However, there is considerable anecdotal evidence (e.g., Sharpenberg, 1983; Borgman, J.D., and Hooverson, R.L., 1981; Probsdorfer, 1980) and other indirect evidence to show that gaming exercises and other terrain board simulations can result in substantial gains in performance that carry over into the field.

Notable examples directly related to Armor applications were the Miniature Armor Battlefield (MAB) and Combat Decision Game (CDG) developed and evaluated by Baker, Cook, Warnick, and Robinson (1964). The MAB used radio-controlled tank models and a large scale terrain board to train tank platoon leaders along with the platoon sergeant, TCs, and crewmen. The CDG provided similar training for platoon leaders using a terrain board and manually controlled tank models.

Both the MAB and CDG were designed to represent specific tactical missions and task requirements, and were validated in field exercises reflecting the same performance requirements. Although vehicles on the US and OPFOR were operated by players in training, the instructor controlled actions of the OPFOR players to create specific situations. An important feature of both methods was that standard command, control, and communication procedures were strictly enforced throughout the training.

A two-week training program with the MAB was found to produce field test performance virtually indistinguishable from combat-experienced platoon leaders, and the CDG was nearly as effective with somewhat less training time. These results demonstrate that properly designed and conducted training with terrain boards can be highly effective. The facilities, equipment, and support needed for both systems was extensive, however, and development of these methods was discontinued.

Since games fielded later for Army training have not been tied directly to defined training objectives and measures of task performance, the precise training effects of gaming experience have not been formally documented acceptance of games as a training method largely rests on tradition and experience. The TACWAR game (Naval Training Equipment Center, 1983) developed for the Marine Corps is a contrasting example designed to meet defined objectives. It provides specific scenarios for training on particular missions and related tasks. TACWAR rules are similar to Dunn-Kempf in a number of ways, but so far an objective evaluation and transfer test has not been published.

Indirect evidence bearing on the training value provided by Dunn-Kempf has been found in research on engagement simulation training. Poor performance by unit leaders, either with the leader becoming a casualty, or directing the unit into counter-productive actions, was found to both embarrass the

leader and reduce the lessons learned by the unit. A mapboard game known as EFFTRAIN was developed as an adjunct to engagement simulation exercises (Shriver, Griffin, Hannaman, and Jones (1974, 1975)). Results indicated that training with the game enhanced leader performance and benefited subsequent ES training (Miller and Bachtta, 1978; Root, Hayes, Word, Shriver, and Griffin, 1979). Later research confirmed this conclusion with a game derived from EFFTRAIN called the Tactical Opposition Exercise (TOX) (Shriver, Griffin, Hannaman, and Jones (1979); Shriver, Jones, Hannaman, Griffin, and Sulzen, 1980). A similar game called Small Combat Unit Evaluation (SCUE), modified from TOX was used to forecast unit effectiveness in MILES exercises. Since the procedures for EFFTRAIN, TOX, and SCUE are similar to Dunn-Kempf and Blockbuster in many respects, some potential training value can be imputed to the latter games based on these findings.

Recent survey results obtained by Henricksen, Jones, Sergeant, and Rutherford (1984) indicate that BS are being used by units for tactical training, though not to the extent desired or expected by their developers. Thirty-eight Armor Officer Advanced Course (AOAC) students were surveyed retrospectively on their tactical training experiences in the four to eight years they had served prior to entering AOAC. While 84% reported using games or other training devices in their units for tactical training, only 50% reported ever using Dunn-Kempf. Smaller percentages of officers also indicated that sandtables, Pegasus, and CAMMS were being used. Their average rating of the amount of nonfield training in units received at the platoon level was 3.10 on a five point scale, with the response "some" equal to a value of 3. Field training was rated at 4.3, between "moderate" and "extensive." The overall adequacy of training was rated at 4.2, slightly above a response of "adequate." On the other hand, when judging specific tasks, a substantial majority agreed that more training was needed on all tasks considered, both in the field (average of 80.4%) across tasks and in nonfield settings (average of 71.6%).

Developmental Criteria. The components and procedures of Dunn-Kempf, Blockbuster, and similar games (TOX, SCUE) were examined to determine what features might be best to retain, and what problems characterized these games. The analysis and comparison of Dunn-Kempf, TOX, and SCUE presented by Jones, Wylie, Henricksen, Shriver, and Hannaman (1980) was most useful in pointing out shortcomings of platoon-level games that should be corrected in the present effort, if possible. For the most part, comments on Dunn-Kempf apply to Blockbuster as well. Based on the features examined, a number of desirable features were defined as criteria for development of the present game.

Features of Platoon-Level Games. Jones, Wylie, Henricksen, Shriver, and Hannaman (1980) examined administrative and playing characteristics relating to (a) player and controller preparation, (b) game control, (c) weapons/vehicles included, (d) simulation of movement and detection, (e) engagement realism, (f) weapons effects realism, and (g) environmental simulation. The three games, Dunn-Kempf, TOX, and SCUE were similar in several respects: (a) they allow platoon and/or company team operations, (b) they involve two-sided free play by multiple players, (c) they include the major combined arms weapon systems, (d) the playing surfaces (map or terrain board) require map-ground associations, and (e) they include play of indirect fire. Three major

differences were that (a) TOX and SCUE use separate playing surfaces and physically separate the players, (b) TOX and SCUE require use of radios and enforce use of communication procedures, and (c) TOX and SCUE simulate a fire direction center (FDC) and requests for fire are channeled to the FDC by radio communications. Opposed to the disadvantages for communication training, the lesser resources required for Dunn-Kempf are an administrative advantage.

As experimental games, neither TOX nor SCUE provided complete documentation. The Dunn-Kempf documentation was judged adequate, although vague in some specific areas (mines, weather, night conditions, etc.) Subsequently the revised rules and additional supplements recently published have clarified many former areas of ambiguity. However, in addition to the features mentioned by Jones, et al., the complexity of the recent rules and the difficulty and time required for player preparation hamper the use of Dunn-Kempf.

In the area of game control, the most serious problem in all games was the discrepancy between combat time (simulated real-time) and playing time. It has been reported that 30 minutes of combat equal eight hours of play in Dunn-Kempf. The problem is less serious in TOX and SCUE, with three hours of combat equal to eight hours of play. Dunn-Kempf is slowed by a lack of controllers and involvement of players in control procedures rather than game play alone. Changes in game mechanics, player and controller aids, and use of additional controllers were suggested to correct this problem.

All the games provided for the use of common Army vehicles and weapons, with a few minor exceptions. Provisions for some adjunct equipment (pyrotechnics, commo wire, engineer equipment, and obstacles) was not complete. Only Dunn-Kempf provided for air support. TOX was judged the most complete game system overall except for air support. The recent Dunn-Kempf revision and supplements fill more of the gaps mentioned. However, some of the combat resolution data, especially for small arms suppression, appears to be questionable for all games.

Gaps appeared in the movement and detection procedures for all games. Rules for movement under fire and/or buttoned up appear to need improvement. The most serious problems concern detection. The TOX and SCUE use detection range tables, recently included in the Dunn-Kempf revision, but do not fully account for line of sight (LOS). On the other hand, judgment of LOS in Dunn-Kempf is difficult visually, requiring the use of a string or mirrors to test LOS at board level. None of the games differentiate between detection and identification, represent clues for detection, or require observation and target search. Rules for operations at night or with limited visibility provide only a partial simulation.

Weapons effectiveness tables were adequate for direct fire against vehicles, but were incomplete for fire on troops. The effects of various kinds of cover and prepared positions are only partly included, and Dunn-Kempf does not have a table for vehicle machinegun fire at troops or antitank weapons.

Blockbuster has such a table, but was not included in the Dunn-Kempf revision. Treatment of factors influencing the effectiveness of mines, artillery, and air support was regarded as inadequate in Dunn-Kempf. None of the games represent visual cues resulting from fire.

Procedures for continuation of engagements and suppressive effects were judged to be rather unrealistic. The resolution of simultaneous fire, and multiple fires on one target, and other aspects of situations with multiple units or vehicles in a combined firefight were considered poor for Dunn-Kempf. However, features of Blockbuster incorporated in the Dunn-Kempf revision have largely corrected this problem. Dunn-Kempf was the only game to give some consideration to electronic warfare (EW) in its rules, and to the resulting effects of loss of communication on indirect fire.

TOX and SCUE were judged to provide fairly realistic simulation of most combat environmental factors considered, except for the lack of air support and EW. Dunn-Kempf was reasonably realistic except in the area of communications. The failure to simulate radio communications and enforce communication procedures was regarded as a major defect. The terrain board, on the other hand, was considered superior to maps with contour line representation of terrain.

Desirable Features for TRAX I. Administrative features were adopted as guidelines for game development if they were considered to raise the prospects for successful implementation of the game by potential users in the unit setting. Training aspects of simulation and game procedures were selected if they were considered important to training effectiveness and potential transfer to field performance.

(1) Administrative Features

(a) Resources. The facilities, equipment, and materials required in the game should be limited to those currently available in a unit, or possible to purchase or construct locally.

(b) Preparation. Planning exercise preparation, and equipment setup time should not exceed that for Dunn-Kempf and other games in current use, and should be reduced if possible. The difficulty of controller and player training, and time expended on prior to the game exercises should be minimized.

(c) Personnel. The number of support personnel needed as controllers should be minimized, and the number and qualifications of personnel required should be available at company level without outside assistance.

(d) Documentation. Game documentation should be complete and self-explanatory, so that the game can be effectively used locally without having received a previous demonstration, or fielding by a special team.

(e) Scheduling. Gaming exercises should be completed within half-day periods to aid scheduling of personnel and facilities.

(2) Training Features

- (a) Player Procedures. Player actions should mimic or represent actions actually performed in a platoon context in the field. Extraneous game mechanics should be minimized, or camouflaged within the playing procedures.
- (b) Controller Procedures. Controllers should handle all aspects of the game other than those directly involved in platoon operations. Procedures should represent all aspects of combat situations having important influences on player decisions and actions.
- (c) Rules of Play. Rules should be simplified to ease learning of the game system, and minimize the delay before starting play.
- (d) Memory Aids. Materials and procedures should be designed to directly cue game mechanics to reduce memory load for both players and controllers.
- (e) Time Constraints. The pace of play should be increased over current games, and other limitations used so as to realistically represent time factors affecting decisions and actions.
- (f) Target Acquisition. Game procedures should represent processes and factors influencing target detection, recognition, and identification, and their effects on engagement results.
- (g) Communications. Standard communications procedures should be required and enforced, including use of communications other than radio.
- (h) Objectives. Exercises should require practice of identifiable tasks, and support an approved training structure contributing to mission readiness.
- (i) Conditions. Game events should be controlled to produce appropriate conditions for task performance, representative of common conditions encountered in field exercises and expected in combat.
- (j) Mission Planning. Leaders should be required to perform planning activities and troop leading procedures as normally required in combat circumstances.
- (k) Problem Solving. Common problem situations should be encountered in game exercises, and be solvable by common tactical decisions and actions (so-called 80% solutions.)
- (l) Knowledge Limitations. Players should acquire only that situational information during play that they would normally obtain in a similar situation in a field exercise or combat.
- (m) Engagement Effects. Effects of fire, direct and indirect, should realistically represent casualties, damage, and suppressive effects to be expected under similar circumstances in combat.

(n) Player Casualties. Players should not be removed from play and lose further training by becoming a casualty. Casualties should not result in tasks being bypassed, or lead to performance under radically altered conditions.

(o) After-Action Review. Performance evaluation and review should follow procedures similar to those recommended for engagement simulation exercises. Causal connections from player decisions and actions to resulting combat outcomes should be emphasized, along with parallels with field situations and implications for training.

DEVELOPMENT PROCEDURES

Conforming to the objectives of the project and the developmental criteria that were adopted, three early decisions were made that had major influences on the final game produced. First, the basic framework adopted for the game system was one-sided play with controlled, preplanned occurrence of major combat events and OPFOR actions. This was considered necessary if a specifiable training structure was to be maintained.

Second, the planned scenarios were to be designed on the basis of the missions outlined in MTP 17-15-1, including tasks specified either as prerequisites or those performed in the STXs for those missions. This assured that the game exercise would directly support leader preparation for STXs and FTXs, and that the potential impacts on performance in such field exercises could be specified.

Third, the SIMFAC game system, along with Dunn-Kempf materials and equipment, was adopted as the starting point for development of rules and procedures. Olmsted, J.A., Hannaman, D.L., Kraemer, A.J., Elder, B.L., Henricksen, K. F., and McConnell, J.N. (1981abcd) designed the SIMFAC game as a manually-controlled prototype for development of a computer automated tactical performance and training research facility. The game design allowed either one-sided controlled play, or two-sided free play. The game system combined desirable features of Dunn-Kempf, Blockbuster, and TOX/SCUE. It had been tried out on a small scale, and appeared to be workable. However, like the other games, particular features required to simulate Division '86 operations had not been included.

Rules Development. An initial set of rules was written based on the SIMFAC Player/Controller Guide. Modifications were introduced to reflect the developmental criteria that had been adopted, and to create player capabilities for simulating Division '86 tactics.

The main areas of difference between SIMFAC and the first version of TRAX I can be briefly summarized. The "open mode" of play was adopted requiring one terrain surface, and references to the "closed mode," with separate US and OPFOR boards were eliminated. The Dunn-Kempf terrain board and revised materials were to be used, rather than the enlarged maps and Blockbuster materials in SIMFAC. Rules for player procedures were restricted to those required to operate a four tank platoon (usually M1 tanks) equipped with thermal sights, stabilization, secure radios, onboard exhaust smoke and

smoke grenades, and no HEP or WP ammunition. Communications were limited to standard radio procedures or hand signals. A combat resolution table was provided for the specific vehicle used by each player. Some additional rules providing Infantry support with M2/3s or M113s were included, to allow scenarios with Infantry.

The major innovations were in the use of action cards and detection cards. Action cards showed the allowable movement and firing sequences from SIMFAC that were modified from Dunn-Kempf and Blockbuster. One card was provided for each allowable sequence. The players were also provided movement capabilities chart listing the sequence and movement distances for the platoon vehicles. New equipment (M1, M2/3, T64/72) was given increased mobility capabilities over their earlier counterparts. The action cards were designed to help reduce player's memory load during play. Detection cards were introduced to represent the target acquisition process and control target information. Action cards and a gun marker were also used by the player to show the TC's and gunner's field of observation. Detection rules associated with the cards required continuous player attention to maintain platoon security and react promptly to OPFOR engagement.

Game procedures not directly related to execution of platoon actions were assigned to controllers. The Instructor/Controller supervised play and simulated communications as company commander or First. The turn was divided into a fire/movement and indirect fire/communication phase to enable the Instructor/Controller to perform both duties. Player communication to company or higher level was limited to the latter phase. An Air/Indirect Fire Controller and an OPFOR Controller assisted the Instructor/Controller. The Air/Indirect Fire Controller duties combined those specified in SIMFAC, while the OPFOR controller was made responsible for detection cards, OPFOR movement and fires, and OPFOR direct fire resolution.

Scenario Development. Exercise scenarios were initially drafted by an Armor officer with extensive experience as a senior instructor in the Armor School Command and Staff Department. As an instructor, he had been involved in the development of Division '86 doctrinal literature and was thoroughly familiar with current major changes in tactical doctrine.

Missions selected for training were the Movement to Contact/Hasty Attack, and Occupy Battle Position/Hasty Defense. These missions had high priorities for training according to surveys of task criticality (e.g., Drucker, Hoffman, and Bessemer, 1983) and were directly related to STXs in MTP 17-15-1. The Tactical Road March was also selected as an appropriate context for relatively brief, simplified introductory exercises that would be useful in mastering the rules and method of play prior to training in the more complex scenarios.

A list of tasks from FC 17-15-1 was prepared for each mission, and sequenced in an order that they might reasonably be expected to occur in combat. The nature of the situation and mission were conceptualized, and terrain board areas and routes selected for execution of the mission. Two versions of the Road March exercise were planned, to allow a repetition of this mission after initial practice on the method of play.

An OPORD or FRAGO was then prepared along with a map overlay, to realistically represent the orders and information that would be given the platoon leader in such a situation. A scenario timeline was developed in the format of a training schedule, specifying the platoon positions and events introduced to control the sequence of tasks and the conditions for Task performance.

Performance standards were also listed for each task, consisting of performance elements for the leader and platoon that were appropriate under the circumstances. The standards usually corresponded to one or more of those specified for the task in FC 17-15-1.

The scenarios were played out several times with ARI staff as part of their training as controllers. The scenarios were then rewritten to reduce ambiguities in the orders, and events modified or reordered to smooth out the flow of action and reaction between OPFOR and US sides. The initiating conditions for events were revised to make the occurrence of task conditions appear more natural (less arbitrary) in the context of the tactical situation existing at the time.

Initial Tryout. The tactical road march scenarios were tried out with two groups of four Armor Officer Basic (AOB) students, and two groups of four Armor Officer Advance Course (AOAC) students. The AOB students were used to examine the feasibility of the method with the planned target population to be trained, while the AOAC students were asked to judge the validity of the simulation, and potential value of the system for training. Participants completed the two Road March exercises and either the Attack or Defense exercises in a day-long training session.

Experience in the tryouts suggested that major revisions were needed. The rules were universally regarded as too lengthy, complex, and difficult to retain and apply in the gaming procedures. The pace of play was very slow compared to that expected and desired. The pace was slowed by two major factors. The players tended to communicate frequently and at great length about what to do in each turn, in a way that was totally unrealistic in relation to the simulated combat time. Second, the players tended to be very slow in using the movement capabilities chart and fire resolution table. They had difficulty in understanding the charts to begin with, and later spent considerable time contemplating how to maximize their advantages within the movement and firing capabilities available.

The action cards proved to be too numerous, and it was difficult for the players to find the one desired. The players also had difficulty in knowing what they were allowed to do on successive steps of the turn sequence. Being forced to keep one card through the turn did not permit realistic reactions to events. The action card was also found to be clumsy as an observation indicator, being too large when several vehicles were close together. With charts, cards, vehicle, and gun marker, the players felt they simply had too many objects to handle.

The players generally approved of the principle of action cards and observation markers, feeling that they encouraged them to think about coordination of their actions in the platoon in a way that they had not experienced in previous training. They also generally approved of the detection cards and the way target acquisition was represented.

Both the AOB students and the AOAC students agreed that the level of detail represented in the game aided insight into the sources of errors, and helped to develop tactical foresight. The sequences of events and conditions introduced in the scenarios were regarded as generally realistic. It was felt, however, that more general background information on the situation was needed as a context for the orders given. Numerous suggestions were given concerning details in the rules that might be improved.

The overall reaction of the AOB students was that the game situation was an improvement over the terrain board training they had previously received, and that the experience could be helpful to their performance in the field. The judgment of the AOAC students was that the game had considerable training potential for the mission and tasks presented. However, they were concerned that the time available in the unit was so limited that it would be hard to implement the training to the extent needed.

The controller duties also appeared to need some modification. The Instructor/Controller had some difficulty in keeping track of the turn steps, and properly controlling what actions could be done at which steps. The Air/Indirect Fire Controller appeared to have little to do, while the OPFOR controller had more to do than he could handle when he was engaging targets and determining results of fire.

Revision of Rules and Materials. A number of substantial changes in the gaming method were made based on the initial tryout. The action cards were reduced to four, representing the action alternatives available, with the Instructor/Controller simply announcing the kind of action allowed on each step. Players were allowed to change the action card once per turn, with a few exceptions described in the rules. A small field of view marker was substituted for the action card as a means of indicating observation.

The movement capabilities chart was eliminated, and the allowable distances were added to the back of the action cards. The player's combat resolution table was eliminated. Direct fire procedures for the players were reduced to target designation, and determination of LOS and range. Acquisition range tables were eliminated in favor of simple visibility rules.

An important change was made in the communication rules. The Instructor/Controller was made responsible for timing and limiting communications to the 30 seconds corresponding to the real time represented by the turn. This procedure was suggested by the officer who had developed the scenarios and served as Instructor/Controller in the tryout. It was felt that this would impose a realistic constraint on command and control, and help to speed up play substantially.

The rules were extensively rewritten to remove all extraneous material, simplify the procedures, and clarify the language as much as possible. Many special conditions, exceptions, and complications were either eliminated or transferred to a set of advanced rules. The basic rules were reduced to a bare minimum considered necessary to carry out the actions of a tank platoon (observe, move, shoot, and communicate) with the special capabilities of the vehicles and weapons used.

The Air/Indirect Fire Controller duties were changed to include responsibility for all direct and indirect fires, while the OPFOR controller duties were limited to carrying out those controller actions done on the terrain board. This allowed the Fire Controller to remain seated at the edge of the board to work with charts and tables, while the OPFOR controller moved around the board to place, move, and remove any objects used.

Final Validation and Revisions. As a final test of the method of play, twelve pairs of AOB students and sixteen pairs of AOAC students were given both Road March exercises. In these exercises, each member of a pair operated two tanks in the roles of platoon leader and platoon sergeant. After the first road march, the roles were reversed on the second. Performance data was collected for comparison between groups, and responses to questionnaires were obtained.

The changes in the gaming methods were successful in speeding up play to an acceptable rate, and the earlier problems seemed to be almost entirely eliminated. Participants were able to learn the rules and complete both exercises in a four hour period. This included time for reasonable after-action reviews after each exercise.

With few exceptions the players liked the game, thought it was a valuable method of training, and wanted more of it. The AOB students were particularly enthusiastic, some indicating that the game was even better than the field training that they had received. The more experienced AOAC students were generally positive, and felt that they could make good use of the game to train their subordinates. Most agreed that TRAX I was markedly improved over Dunn-Kempf. Requirements for all-round-security, rapid and coordinated actions on contact, and brief and clear communications were thought to be the most valuable aspects of the experience. Occasionally, they expressed concerns about the validity of minor technical details relating to weapon capabilities.

In the second exercise, performance was improved several ways, and the improvement did not appear to be simply a function of increased mastery of the rules as play progressed. The change was most dramatic in communication procedures. Even the AOAC students frequently ran out of commo time at the beginning, and calls for fire were slow and ineffective. By the end of the second exercise, platoon communications were infrequent and relatively brief. Calls for fire were better organized and more often completed within the 30 second limit.

The Instructor/Controller was able to keep play moving along within the planned scenario without much difficulty. The OPFOR controller was not overloaded in these scenarios, and did not have difficulty in following the scenario. The Fire Controller was able to handle both direct and indirect fires. Direct fire results were rapidly determined with only occasional interruptions and delays in play when there were heavy exchanges of fire between the US platoon and the OPFOR.

While the method of play has been confirmed as workable, limitations on the time period available for officer participation prevented thorough trial of the Attack and Defense exercises. Each exercise only could be tried out on one occasion. The Attack exercise worked smoothly except at a couple of points. There were greater problems in the sequences of events in the Defense exercise. Furthermore, the OPFOR had difficulty in handling the large number of vehicles used in the latter scenario.

Minor revisions have been made to the Attack scenario to correct problems observed. The Defense exercise was extensively revised to improve the sequencing, reduce the OPFOR vehicles present at any one time, and include more tasks related to occupation and preparation of battle positions.

The final versions of the Attack and Defense exercises have not been tried out following final revision, and imperfections may still be present, particularly in the Defense exercise. An assistant OPFOR controller may be necessary to speed play in the second phase of the Defense exercise, when the bulk of the OPFOR appears on the board. Local tryout and further improvement of these exercises by users may be necessary. The Road March exercises, however, should work well without change.

The rules have been revised a second time to include more explanation of the rationale behind the rules, and how they may be used to represent various actions. The main purpose in revision was to help the rules be more self-explanatory. Only very minor further changes and adjustments to the method of play were made in the final version of the rules.

To complete a training package for users, TRAX I has been documented in a report (Bessemer, 1984) presenting a Controller's Guide, Basic Rules and Advanced Rules. Exercise Plans are presented to support training, providing a lesson plan with each mission scenario. Matrices show the tasks included in each exercise, and their relationship to the STXs in the tank platoon MTP. Requirements for facilities, equipment, and materiel are also described.

RESULTS

Responses to post-exercise questionnaires by both AOB and AOAC students were highly positive. The most encouraging testimonial was provided by the 93% who agreed that TRAX I provided "effective" or "very effective" training. Among those AOAC students with previous experience in playing Dunn-Kempf, 91% agreed that TRAX I provided "better" or "much better" training than the original method of play (most had not used the revised version of Dunn-Kempf). The worst response on the negative side concerned the fidelity of the combat simulation. Only 65% overall considered TRAX I to be an "accurate" or "very

accurate" simulation, while 14% agreed that it was "somewhat" or "very inaccurate," with the remainder in-between. However TRAX I was considered more accurate than Dunn-Kempf by 66% of those officers that had used the latter game.

While the training effectiveness of TRAX I was not evaluated by effects on later field performance, there is indirect evidence that suggest that training with the game should prove to have some value. Observations of player performance indicated several common faults. To briefly summarize the observations, it is interesting to note that many of the same kinds of incidents and tactical problems observed at the National Training Center (NTC) at the platoon level (e.g., Furlong, 1984; Wagner, 1984) also were found to occur in the game. Overall, the performance of the AOAC officers was much superior to the AOB officers. Performance reflecting the difference in prior training and experience between the groups should be observed in a valid game. Furthermore, after only one exercise repetition performance improved in several aspects of play, with the AOB officers showing the greater improvement in most cases. Further detailed results on exercise performance will be presented in a later report.

While the effectiveness of training with TRAX I cannot be guaranteed on the basis of the evidence gathered to date, the preliminary indications are favorable. At the very least, the STX-like game exercises provide the instructor with ample opportunity to observe and correct common tactical errors. With proper follow-through in after-action reviews, there is every reason to expect that game exercises should contribute to the effectiveness of later field training.

CONCLUSIONS

The TRAX I game system permits frequent tactical training at low cost for leaders of small units and crews. The training method is compatible with the programs, objectives, and training approaches currently recommended for Division '86 Armor units. Modifications of the Dunn-Kempf game introduced in TRAX I have been reasonably successful in reducing playing time, simplifying rules and procedures for players, and tying game practice closely to Division '86 training objectives. These advantages are somewhat offset by the larger number of controllers and increased controller training required to operate the game system effectively.

Without question, numerous features of the TRAX I game system can stand further improvement. Nevertheless, the playing techniques and training methods demonstrated in TRAX I provide a workable basis for systematic application of tactical gaming in Division '86 unit training programs.

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